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This paper proposes computer assistance in the synthesis operation of vocational counseling. The goal of vocational counseling is to match the client with a vocation in which he will be both satisfied and satisfactory. The computer would, through its rapid scanning and computation, produce probabilities of satisfactoriness based on (1) the individual's unique pattern of vocational abilities, and (2) individual differences in ability requirements of various occupational environments. Probabilities of satisfaction would be based on (1) the individual's vocational needs, and (2) information on the reinforcer characteristics of various occupational environments. These four lists of potential jobs would result: those in which the client would be (1) satisfied and satisfactory, (2) satisfied and unsatisfactory, suggesting training, (3) unsatisfied but satisfactory, and (4) unsatisfied and unsatisfactory. The computer could also be used in individualizing assessment techniques which provide the banks of data on which the probabilities are constructed. The advantages would be time saving, increased motivation, simultaneous prediction, clarification of reliability, and the greater amount of information at the counselor's disposal. (BP)

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Computer-Assisted Synthesis of Psychometric Data in Vocational Counseling

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Effective counseling is based on assessment, by the counselor, of aspects of the personalities of his counselees. In counseling which centers around an individual's personal problems, the counselor and the counselee jointly explore the nature of the counselee's problems; in other words, they are assessing the relevant aspects of the counselee's personality. In this type of counseling, once the problems are identified, the counselor must assess the counselee's adjustive capacities and styles to evaluate various modes of solving the problems. For some individuals, prolonged counseling with a goal of personality change is indicated; for others, selective reinforcement of certain behaviors is appropriate; and for still others, the counselor might assist the individual in finding an environment which will minimize or eliminate the problems. The particular combination of solutions arrived at by the counselor and counselee is based on individual differences in each counselee's problems, capabilities, needs, and other aspects of the situation which brought him to the counselor.

The emphasis on assessment of individual differences within the total counseling specialty is perhaps most obvious in the area of vocational counseling. It is in this area of counseling that direct assessment of the counselee is most frequently utilized. Assessment in vocational counseling frequently results in a wide array of "hard" data

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describing individual differences in many aspects of the counselee's personality. Consequently, it is in vocational counseling that computers are likely to be of maximum use to the counselor in both obtaining assessment data, and in synthesizing these data for use by the participants in the counseling enterprise.

A Model for the Synthesis of Psychometric Data in Vocational Counseling

Interpretation vs. Synthesis. Computer-based systems for utilization of psychometric data in vocational counseling can be considered as either interpretative systems, or as synthesizing systems. The objective of these two systems are somewhat different.

Computer-assisted interpretation systems are those which assist the counselor in translating test scores into descriptive statements of individual differences. Such systems exist now for such instruments as Cattell's 16-PF Questionnaire, as indicated earlier by Dr. Eber, and for the MMPI. These computer-based interpretation systems assist the counselor in translating a psychometric profile into terms which are understandable to him, and sometimes communicable to the counselee. The objective of such interpretation systems is the description of individual differences in natural language, to assist in the identification of problems, or relevant aspects of the counselee's functioning.

Computer-based systems for the synthesis of psychometric data have a somewhat different objective. Rather than providing the counselor with an increase in the amount of information he must consider, which is a characteristic of most interpretive systems, synthesizing systems are oriented toward reducing the counselor's investment of time in mechanical data interpretation, thereby freeing his time for the more complex aspects of counseling, such as communicating, reacting, and helping.

Objectives of vocational counseling. A system for the synthesis of individual differences assessment data must have a clearly-defined objective. In vocational counseling the goal, as well as the means, of assessment, is clear: Assist the counselee in finding a vocation in which he is likely to be both satisfied and satisfactory. That is, the individual should be assisted to consider those jobs, occupations, vocations or careers in which he will be as happy as possible, and in which others (his employer, primarily) will feel that he is performing to the best of his abilities. It is in these vocational environments that the individual is likely to become maximally adjusted.

Once the goals of the counseling process are defined, the information necessary to develop our synthesizing system becomes clear. We require a computer-based system that will give the counselor information of the following sort: In what occupational environments is this individual likely to be both satisfied and satisfactory? In what occupational environments is the individual likely to be both dissatisfied and unsatisfactory? The former set of occupations are desirable outcomes for the individual; the latter set are undesirable outcomes. An additional output of such a system might also include those occupations in which the individual is likely to be satisfied but not satisfactory. These occupations might suggest to the counselor viable occupational possibilities, provided that the individual successfully completes some prerequisite training to improve his predicted satisfactoriness. The fourth possibility, those occupations in which the individual is predicted to be satisfactory but not satisfied imply a less desirable environment for the counselee. Yet such occupations may be important ones for individuals from atypical backgrounds, such as minority group

members, provided that the job environment can be re-structured to increase the individual's satisfaction. These occupations may also be relatively temporary entry occupations to other jobs with more desirable work adjustment Possibilities.

The computer-based system. Once the objectives of the counseling process are defined in this way, the data relevant to these objectives become clear, as does the synthesizing function of the computer. Probability of satisfactoriness in various job environments can be evaluated from two sets of information: 1) assessment of an individual's profile of his unique pattern of vocational abilities; and 2) assessment of "individual differences" in the ability requirements of various occupational environments. The former is measured by such instruments as the General Aptitude Test Battery; the latter can be measured, using the same sets of variables, by the U.S. Employment Service's Occupational Aptitude Patterns, or the Estimates of Worker Trait Requirements as embodied in the 114 Worker Trait Groups of the Dictionary of Occupational Titles.

Given these two sets of data--the counselor's psychometrically-based assessment of the individual's abilities and the ability requirements of a wide variety of occupations--the correspondence between the two multivariate sets of information will give the counselor predictions of satisfactoriness. Those occupations for which the counselee's ability pattern correspond with the ability requirements of the environment, are those in which he is likely to be satisfactory; those occupations whose requirements do not correspond with the individual's abilities are those in which unsatisfactoriness is predicted.

The computer, as a synthesizer and counselor aide, has its first task: Given this individual's pattern of abilities, help me determine in which occupations he is likely to be satisfactory. The computer then takes any number of jobs, whether it be 40, 4,000 or 40,000, and tirelessly matches individual ability patterns to job requirement patterns. The result is a synthesis, a "boiling down" of a large amount of information to a relatively manageable amount for the counselor. The result might be a simple statement such as "This individual is likely to be satisfactory in the following occupations ...." The computer has done, in less than one second, what the counselor might spend hours on. It has performed a synthesis which the counselor could have done himself, but which counselors rarely do, largely because of limited time as the result of ever-increasing case loads.

Estimation of probable satisfaction in various occupations can be approached in a similar way. Again, two sets of variables are relevant to this prediction: 1) assessments of an individual's vocational needs, and 2) information on the reinforcer characteristics of various occupational environments. Vocational needs can be measured by such instruments as the Minnesota Importance Questionnaire. In this assessment device, the individual scales 20 occupational reinforcers to describe his ideal job environment. Needs are measured as preferences for such things as a job which has steady employment, good working conditions, opportunities for advancement, and the exercise of responsibility and authority. Analagous to the ability requirements model, jobs are differentiated in terms of the reinforcers they provide. These Occupational Reinforcer Patterns, recently developed by the Work Adjustment Project of the University of Minnesota, describe jobs in terms of

how much responsibility, authority, opportunities for advancement and so on, they offer.

Since the Minnesota Importance Questionnaire and the Occupational Reinforcer Patterns are constructed on the same dimensions, the amount of correspondence can be determined between the two profiles. High correspondence is related to high satisfaction; low correspondence predicts dissatisfaction.

We now put our computer to work again, and ask it to tell us in which occupations the individual is likely to be satisfied. It then takes the individual's unique MIQ profile, compares it to the ORPs for a variety of occupations and may print out the following statement: "This individual is likely to be satisfied in the following occupations...." Again, in less than a second, the computer has synthesized a wide variety of multivariate information on a large number of jobs, and summarized the result in a form readily usable by the counselor for the problem at hand.

Given then, the assessments of the individual's unique work personality, as reflected in his pattern of abilities and needs, and a computer which "knows" and "never will forget" the Occupational Ability Patterns and Occupational Reinforcer Patterns of hundreds or thousands of occupations, vocations, or jobs, we are ready to assist the counselor in fulfilling our previously defined objective of vocational counseling. By combining the previously illustrated information into even more usable form, the computer can now tell us in which occupations the counselee is likely to be satisfied and satisfactory, dissatisfied and unsatisfactory, or one of the other two outcomes indicated previously. This computer-assisted synthesis of counselee assessment data and occupational information data, presented to the counselor in its most usable form, should

provide the counselor with information from which counseling and subsequent plan-making can proceed. Parts of such a computer-based system are now operational, and the entire system will be ready in a few months. Our goal is an individualized synthesis of the work personality data for each counselee.

Computer-Assisted Assessment

While the technological advancements in the computer area are concerned with individualizing interpretation and synthesis of assessment data, as well as individualizing prediction systems and the counseling process, little attention has been given to the process of individualizing the assessment procedures themselves.

With the use of computer technology, assessment for vocational counseling is finally in a position where it can be truly individualized. The usual psychometric assessment procedures and concepts could be radically changed by the computer technology.

Currently, assessment of an individual's work personality is based on a common battery of psychological tests, questionnaires and inventories. Each individual responds to all items of all instruments, with no attention given to individual differences during the testing procedure. This has resulted in the "standardized test" which, by its very nature, requires that the individual adapt his behaviors to the test. Truly individualized assessment would adapt the test to the individual. We now waste much time in assessment asking individuals to answer test items which are far too easy, or to attempt items which are too difficult. Such practices lead to boredom, on the one hand, or frustration, on the other. Truly individualized assessment could greatly reduce both these problems.

Computer-assisted assessment, as a method for individualizing measurement, requires a return to some previous concepts of measurement and the

rejection of some of the most common superstructure of psychometrics.

To individualize vocational abilities measurement, we should return to some of Binet's concepts, but with modifications. Given some information on a counselee's education, job history, prior test performance, or the like, the computer can be programmed to estimate the individual's probable level of, let us say, verbal comprehension or verbal reasoning ability, or three-dimensional space ability, or form perception, or any of the possibly one hundred or more unidimensional ability domains. Based on this information, testing can begin at the estimated level and proceed upward and/or downward along a dimension of item difficulty until the individual's level is ascertained. This procedure is similar to that which is followed by a psychometrist administering a Stanford-Binet. The differences are 1) that it is done by computer branching techniques rather than a human psychometrist, and 2) that testing is done on unidimensional variables, rather than a more grossly defined "intelligence" scale.

The advantages of such a procedure are many. Most obvious is the savings in time, since individuals would respond to those test items that are approximately relevant to their level on each ability. This time can be used in further assessment on other relevant ability dimensions. Moreover "motivation" can be built into the system by first providing for feedback of correct responses, and secondly insuring that a sufficient number of positive feedback responses will occur, by means of appropriate programming. Such an approach could minimize fatigue and boredom by increasing test-taking motivation. A third advantage of this method is that it could include simultaneous prediction in the assessment procedure.

Thus, if a group of occupations requires a combination of high finger dexterity, verbal fluency and two-dimensional form perception, an individual who does not meet the ability requirements on verbal fluency, would not have to take the other two tests, unless they were also relevant to other predictions for that individual.

Perhaps a major contribution of this type of computerized assessment, with its emphasis on individualization, is a clarification of reliability of measurement for ability measurement. While reliability is best considered relative to a given score of an individual on some scale of measurement, current measurement procedures estimate this reliability from data for a particular group. Computerized testing would enable the estimation of reliability of <u>each measurement</u> for <u>each individual,</u> by repeated testing or presentation of items at and around the observed score, to obtain an estimated interval which includes the "true" score. The width of this interval could be controlled by the counselor or psychometrist for each individual, depending on the accuracy of the information required. The counselor could then say "I'd like an estimate of Mr. X's level on arithmetic computation within $\pm$ 2 points," and receive the answer within minutes. The reliability of the score could be predetermined, and testing would continue until the desired precision was obtained. Obviously, different degrees of reliability would be relevant for different decisions.

Computer-based assessment procedures could also be effectively applied in the measurement of vocational needs. Our current needs measure, the Minnesota Importance Questionnaire, use a pair comparison format, with neutral point. With 20 needs to be measured, we have 190 item pairs, plus 20 items for the neutral point, for a total of 210 items.

Eventually, we hope to identify 50 or more job-relevant needs. With 50 need scales, our MIQ would have 1,225 item pairs plus 50 for the neutral point, giving us a questionnaire of 1,275 items. This would be obviously unfeasible with current measurement procedures.

Using the computer, however, we could present an incomplete pair comparisons, based on possibly 10 to 20 percent of the potential item pool of 1,275. By judicious programming, we would present to a given individual only those item pairs that are necessary to obtain reliable estimates of the scale values he would have obtained had he completed all 1,275 items. This system could also be integrated with our simultaneous prediction system in which probable satisfaction and satisfactoriness are being evaluated, and variables are being eliminated on the basis of these predictions. Moreover, the internal consistency of each individual's responses could be continually monitored, via his circular triad score, and the computer could "inform" an individual (or his counselor) that his responses are becoming illogical or random, and attempt to determine whether it is due to inability to decide, carelessness, inattention or other factors.

Individualized assessment could transform the psychological testing procedure into an interesting task for counselees. A variety of input-output devices could assist in this process, including videoscopes, typewriters, tape recorders, movie projectors, light pens and the like. Through differential use of equipment and individualized reinforcers, such as lights, sounds, tactile sensations, recorded voices, and even candy pellets, individuals could be motivated to perform at their maximum to provide valid and reliable assessment data of their maximum probable performance. In conjunction with an integrated prediction system, the counselee's time in assessment could be minimized, while

measuring 100 or more abilities and 100 dimensions of needs, and giving the counselor a comprehensive yet brief set of statements which synthesize the assessment data for immediate use in vocational counseling.